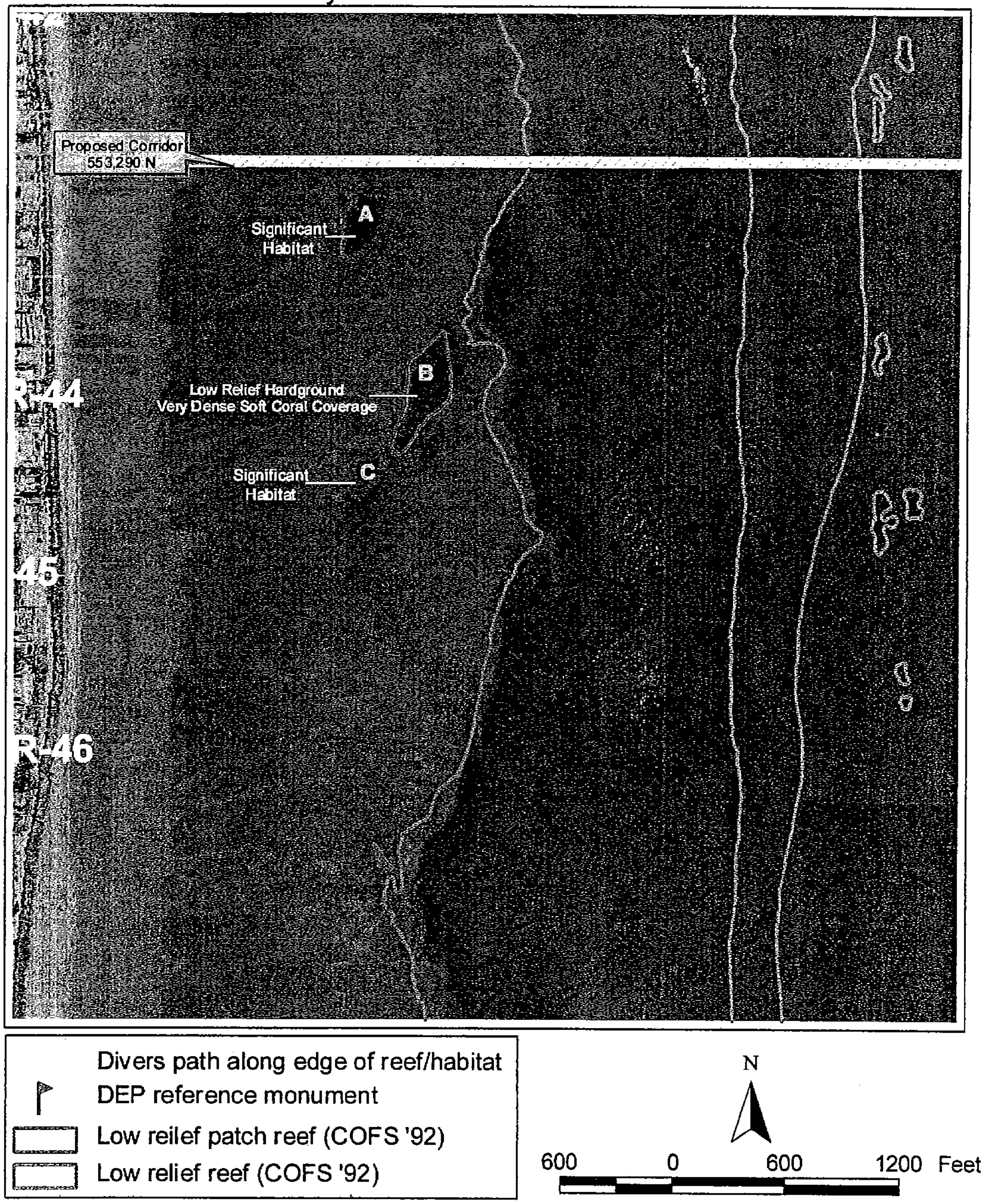
Figure 3:
Alternate Test Beach Fill Area
Survey of Near-Shore Habitat



Appendix A: Summary of Quantitative Transects

(Note: Species name is coded by the first three letters of the species name and the first four letters of the genus name.)

Transect	Category	HC	tally	Area (cm-2)	SC	tally	SP	tally	Other	tally	AL
1	2	DIC STOK	3	60.67	PSE AMER	8	NIP EREC	32	MIL ALCI	7	HAL OPUN
1	2	MEA MEAN	1	3.14	PLE FLEX	2	NIP DIGI	19	PAL CARI	2	DIC BART
1	2	MON ANNU	1	353.43	EUN SUCC	6	AMP COMP	28	STO SABU		RFA SPEC
1	2	MON CAVE	1	6.28	PTE CITR	1	IOT BIRO	13	TUN SPEC		UDO SPEC
1	2	SCO SPEC	1	1.77	BRI ASBE	21	APL FIST	3			BGA SPEC
1	2	SID RADI	8	52.82	EUN CALY	2	APL CAUL	21			CCA SPEC
1	2	SID SIDE	2	7.66	EUN PALM	3	MON SPEC	12			
1	2	SID SPEC	8	35.74			XES MUTA	3			
1	2	STE MICH	6	100.73			NIP AMOR	20			
1	2						CAL VAGI	5			
1	2						MON BARB	14			
1	2						CLI SPEC	7			
1	2						IRC FELI	3			
1	2						PSE CRAS	3			
1	2						DIC RUET	15			
1	2						CAL PLIC	1			
1	2						DYS SPEC	2			
1	2						ECT FERO	2			
1	2						IRC STRO	1			
1	2						MON UNGU	3			
1	2						PTI SPEC	1			
1	2						DIP MEGA	2			
2	2	DIC STOK	4	24.74	PLE HOMO	1	APL FIST	7	STO SABU		DIC BART
2	2	SID SIDE	1	9.42	EUN SPEC	8	AMP COMP	53	MIL ALCI	12	HAL OPUN
2	2	STE MICH	4	47.32	MUR SPEC	1	ECT FERO	3			BGA SPEC
2	2				EUN PALM	16	NIP EREC	34			CCA SPEC
2	2				GOR VENT	1	CHO SPEC	3			BAT SPEC
2	2				BRI ASBE	5	NIP AMOR	14			
2	2				PSE AMER	5	DIP MEGA	1			
2	2				EUN MAMM	1	DYS SPEC	18			
2	2				PTE CITR	1	MON SPEC	4			
2	2				EUN CALY	3	NIP DIGI	2			
2	2				PLE FLEX	2	PTI SPEC	3			
2	2						APL CAUL	8			
2	2						CLI SPEC	3			
2	2						IRC CAMP	3			
2	2						SPO UNID	7			
2	2						DIC RUET	9			
2	2						CAL VAGI	2			
2	2						IRC FELI	1			
3	3	DIC STOK	1	1.18	MUR SPEC	1	APL FIST	25	MIL ALCI	9	HAL OPUN
3	3	MON CAVE	2	1339.89	BRI ASBE	62	NIP AMOR	5	BAR ANNU	3	DIC BART
3	3	POR SPEC	1	0.79	EUN CALY	22	AMP COMP	8			UDO SPEC
3	3	SID RADI	1	0.79	PLE FLEX	16	CIN SPEC	1			
3	3	SID SPEC	4	11.78	EUN SUCC	3	PSE CRAS	1			
3	3	STE MICH	1	12.57	PLE SPEC	6	PTI SPEC	3			
3	3				PLE NUTA	3	IRC STRO	4			
3	3				GOR VENT	5	DIC RUET	5			
3	3				EUN PALM	41	CAL VAGI	5			
3	3				PTE CITR	3	NIP EREC	5			
3	3				PSE AMER	19	DYS SPEC	1			
3	3				EUN SPEC	32	XES MUTA	1			
3	3				PSE ACER	2	CLI SPEC	1			
3	3				PSE SPEC	9	IRC FELI	2			
3	3				PTE ANCE	1					
3	3				EUN MAMM	1					

3	3				EUN KNIG	2					
3	3				PLE HOMO	1					
4	3	ACR CERV	2	22.78	PTE CITR	9	NIP AMOR	11	MIL ALCI	4	DIC BART
4	3	AGA SPEC	1	9.42	PLE FLEX	2	MYC LAEV	1	PAL CARI	8	CCA SPEC
4	3	DIC STOK	3	33.77	BRI ASBE	47	ANT VARI	3			HAL OPUN
4	3	DIP CLIV	1	74.22	EUN SUCC	3	NIP EREC	12			
4	3	MON CAVE	2	617.32	EUN CALY	3	DIC RUET	10			
4	3	POR ASTE	6	479.88	GOR VENT	6	AMP COMP	19			
4	3	SID RADI	3	35.74	PSE SPEC	3	APL FIST	5			
4	3	SID SIDE	1	6.87	PSE AMER	3	IRC FELI	3			
4	3	SID SPEC	3	11.00	EUN SPEC	2	DYS SPEC	6			
4	3	STE MICH	2	3.14	EUN PALM	2	SPH VESP	1			
4	3				PSE ACER	1	NIP DIGI	3			
4	3				PTE SPEC	4	ECT FERO	1			
4	3						HOL HELW	1			
4	3						CHO SPEC	3			
4	3						PTI SPEC	2			
4	3						IRC STRO	1			
4	3						IRC CAMP	1			
5	2	ACR CERV	2	26.70	BRI ASBE	64	STR SPEC	1	MIL ALCI	12	DIC BART
5	2	POR SPEC	2	12.76	EUN SPEC	11	NIP EREC	12	PAL CARI	3	HAL OPUN
5	2	SID RADI	7	5.69	EUN PALM	5	CHO SPEC	4	ZOA PULC	3	UDO SPEC
5	2	SID SIDE	2	35.74	PSE AMER	3	APL FIST	4			CCA SPEC
5	2	SOL BOUR	3	573.34	PSE SPEC	4	ECT FERO	1			AMP RIGI
5	2				PLE NUTA	4	AMP COMP	5			
5	2				PTE ANCE	2	IRC STRO	1			
5	2				EUN MAMM	3	DYS SPEC	13			
5	2				PLE FLEX	6	DIC RUET	5			
5	2				PLE HOMO	3	NIP AMOR	3			
5	2				EUN CALY	1	NIP DIGI	1			
5	2				GOR VENT	1	CIN SPEC	1			
5	2				PSE BIPP	1	PTI SPEC	5			
5	2				PTE CITR	1	IRC FELI	1			
5	2						CAL VAGI	2			
5	2						IRC CAMP	3			
5	2						APL CAUL	1			
6	3	POR SPEC	4	28.27	BRI ASBE	34	NIP EREC	13	MIL ALCI	14	CCA SPEC
6	3	SID RADI	10	21.79	PSE AMER	2	AMP COMP	12	STO SABU		DIC BART
6	3	SID SPEC	12	24.15	EUN SPEC	9	IRC FELI	2	PAL CARI	3	HAL OPUN
6	3	SOL BOUR	1	100.53	PLE NUTA	16	CAL VAGI	1	MIL COMP	1	AMP RIGI
6	3	STE MICH	1	106.81	PTE CITR	8	APL FIST	5	TUN SPEC		CAU SPEC
6	3				PLE FLEX	5	CON NUCL	3	CAN SIMP		
6	3				EUN SUCC	4	DYS SPEC	2			
6	3				MUR MURI	1	DIC RUET	3			
6	3				GOR VENT	1	SPH VESP	2			
6	3				PTE ANCE	5	PTI SPEC	1			
6	3				EUN MAMM	5	IRC STRO	4			
6	3				ERY CARI	1	NIP AMOR	5			
6	3				PSE SPEC	5	CLI SPEC	1			
6	3						IOT BIRO	1			
6	3						CAL VAGI	1			
7	2	DIC STOK	1	54.98	EUN MAMM	15	ECT FERO	2	PAL CARI	2	BGA SPEC
7	2	POR SPEC	2	10.21	BRI ASBE	41	CIN SPEC	30	MIL ALCI	4	DIC BART
7	2	SID RADI	11	24.35	PLE NUTA	6	APL FIST	15			UDO SPEC
7	2	SID SPEC	1	21.99	EUN PALM	9	CLI SPEC	1			CAU SPEC
7	2	SOL BOUR	1	235.62	EUN SPEC	44	DYS SPEC	1			CCA SPEC
7	2	STE MICH	5	120.95	PSE AMER	3	IRC CAMP	1			HAL OPUN
7	2				PTE CITR	1	CHO SPEC	1			
7	2				PLE HOMO	1	AMP COMP	4			
7	2				PTE ANCE	2	NIP EREC	7			
7	2				PLE FLEX	3	DYS SPEC	4			
7	2				PSE SPEC	3	NIP AMOR	1			
7	2				EUN CALY	21	MON SPE	1			

7	2				EUN SUCC	25	CAL VAGI	2			
7	2				PSE AMER	2	ANT VARI	1			
7	2				GOR VENT	1					
7	2				MUR SPEC	1					
7	2				PTE SPEC	2					
8	2	DIC STOK	1	1.57	PSE ACER	5	CLI SPEC	1	MIL ALCI	5	CAU SPEC
8	2	POR SPEC	10	113.88	PLE NUTA	2	NIP AMOR	4			HAL GOUR
8	2	SID RADI	18	41.58	EUN SUCC	11	CIN SPEC	1			BGA SPEC
8	2	SOL BOUR	1	23.56	PTE ANCE	6	NIP EREC	2			UDO SPEC
8	2	STE MICH	2	190.85	BRI ASBE	19	IRC STRO	2			DIC BART
8	2				EUN SPEC	3	IRC SPEC	1			CCA SPEC
8	2				PSE SPEC	4	CIN SPEC	6			
8	2				ERY CARI	2	ANT VARI	1			
8	2				EUN CALY	5	AMP COMP	5			
8	2				PTE SPEC	5	APL CAUL	1			

Appendix B: Species Density (ind/m^2)

Hard Coral

Species	Density
ACR CERV	0.04
AGA SPEC	0.01
DIC STOK	0.13
DIP CLIV	0.01
MEA MEAN	0.01
MON ANNU	0.01
MON CAVE	0.05
POR ASTE	0.06
POR SPEC	0.19
SCO SPEC	0.01
SID RADI	0.58
SID SIDE	0.06
SID SPEC	0.28
SOL BOUR	0.06
STE MICH	0.21

Soft Coral

Species	Density
BRI ASBE	2.93
ERY CARI	0.03
EUN CALY	0.57
EUN KNIG	0.02
EUN MAMM	0.25
EUN PALM	0.76
EUN SPEC	1.09
EUN SUCC	0.52
GOR VENT	0.15
MUR MURI	0.01
MUR SPEC	0.03
PLE FLEX	0.36
PLE HOMO	0.06
PLE NUTA	0.31
PLE SPEC	0.06
PSE ACER	0.08
PSE AMER	0.45
PSE BIPP	0.01
PSE SPEC	0.28
PTE ANCE	0.16
PTE CITR	0.24
PTE SPEC	0.11

Sponges

Species	Density
AMP COMP	1.34
ANT VARI	0.05
APL CAUL	0.31
APL FIST	0.64
CAL PLIC	0.01
CAL VAGI	0.18
CHO NUCL	0.13
CIN SPEC	0.39
CLI SPEC	0.14
DIC RUET	0.47
DIP MEGA	0.03
DYS SPEC	0.47
ECT FERO	0.09
HOL HELW	0.01
IOT BIRO	0.14
IRC CAMP	0.08
IRC FELI	0.12
IRC SPEC	0.01
IRC STRO	0.13
MON BARB	0.14
MON SPEC	0.17
MON UNGU	0.03
MYC LAEV	0.01
NIP AMOR	0.63
NIP DIGI	0.25
NIP EREC	1.17
PSE CRAS	0.04
PTI SPEC	0.15
SPH VESP	0.03
SPO UNID	0.07
STR SPEC	0.01
XES MUTA	0.04

Other

Species	Density
MIL COMP	0.01
BAR ANNU	0.03
ZOA PULC	0.03
PAL CARI	0.18
MIL ALCI	0.67
CAN SIMP	Species
STO SABU	Not
TUN SPEC	Counted

Algae

Species
AMP RIGI
BAT SPEC
BGA SPEC
CAU SPEC
CCA SPEC
DIC BART
HAL OPUN
RFA SPEC
UDO SPEC

Appendix C: Guide to Species Abbreviations

Hard Corals

code	species
ACR CERV	*Acropora cervicornis*
AGA SPEC	*Acropora* species
DIC STOK	*Dichocoenia stokesii*
DIP CLIV	*Diploria clivosa*
MEA MEAN	*Meandrina meandrites*
MON ANNU	*Montastrea annularis*
MON CAVE	*Montastrea cavernosa*
POR ASTE	*Porites asteroides*
POR SPEC	*Porites* species
SCO SPEC	*Siderastrea siderea*
SID RADI	*Siderastrea radians*
SID SIDE	*Siderastrea* species
SOL BOUR	*Solenastrea bournoni*
STE MICH	*Stephanocoenia michelini*

Soft Corals

code	species
BRI ASBE	*Briareum asbestinum*
ERY CARI	*Erythropodium caribaeorum*
EUN CALY	*Eunicea calyculata*
EUN KNIG	*Eunicea knightii*
EUN MAMM	*Eunicea mammosa*
EUN PALM	*Eunicea palmeri*
EUN SPEC	*Eunicea* species
EUN SUCC	*Eunicea succinea*
GOR VENT	*Gorgonia ventalina*
MUR MURI	*Muricea muricata*
MUR SPEC	*Muricea* species
PLE FLEX	*Plexaura flexuosa*
PLE HOMO	*Plexaura homomalla*
PLE NUTA	*Plexaurella nutans*
PLE SPEC	*Plexaurella* species
PSE ACER	*Pseudoptergorgia acerosa*
PSE AMER	*Pseudoptergorgia americana*
PSE BIPP	*Pseudoptergorgia bipinnata*
PSE SPEC	Pseudoptergorgia species
PTE ANCE	*Pterogorgia anceps*
PTE CITR	*Pterogorgia citrina*
PTE SPEC	*Pterogorgia* species

Sponges

code	species
AMP COMP	*Amphimedon compressa*
ANT VARI	*Anthosigmella varians*
APL CAUL	*Aplysina cauliformis*
APL FIST	*Aplysina fistularis*
CAL PLIC	*Callyspongia plicifera*
CAL VAGI	*Callyspongia vaginalis*
CHO SPEC	*Chondrilla* species
CIN SPEC	*Cinachyra* species
CLI SPEC	*Cliona* species
CON NUCL	*Chondrilla nucula*
DIC RUET	*Dictyonella ruetzleri*
DIP MEGA	*Diplastrella megastellata*
DYS SPEC	*Dysidea* species
ECT FERO	*Ectyoplasia ferox*
HOL HELW	*Holopsammia helwigi*
IOT BIRO	*Iotrochota birotuata*
IRC CAMP	*Ircinia campana*
IRC FELI	*Ircinia felix*
IRC SPEC	*Ircinia* species
IRC STRO	*Ircinia strobilina*
MON BARB	*Monanchora barbensis*
MON SPEC	*Monanchora* species
MON UNGU	*Monanchora unguifera*
MYC LAEV	*Mycale laevis*
NIP AMOR	*Niphates amorpha*
NIP DIGI	*Niphates digitalis*
NIP EREC	*Niphates erecta*
PSE CRAS	*Pseudoceratina crassa*
PTI SPEC	*Ptilocaulis* species
SPH VESP	*Spheciospongia vesparium*
SPO UNID	unidentified sponge
STR SPEC	*Strongylacidon* species
XES MUTA	*Xestospongia muta*

Other

code	species
MIL COMP	*Millepora complanata*
BAR ANNU	*Bartholomea annulata*
ZOA PULC	*Zoanthus pulchellus*
PAL CARI	*Palythoa caribaeorum*
MIL ALCI	*Millepora alcycornis*
CAN SIMP	*Canda simplex*
STO SABU	*Stolonicus sabulosa*
TUN SPEC	*Tunicate species*

Algae

code	species
AMP RIGI	*Amphiroa rigida*
BAT SPEC	*Batophora* species
BGA SPEC	Blue Green Algae species
CAU SPEC	*Caulerpa* species
CCA SPEC	Corallinacean species
DIC BART	*Dictyota bartayresi*
HAL OPUN	*Halimeda opuntia*
RFA SPEC	Red Filamentous Algae species
UDO SPEC	*Udotea* species

APPENDIX H – MITIGATION PLAN

MITIGATION PLAN FOR PLACEMENT OF DREDGE SLURRY PIPELINES ON HARDGROUND AREAS IN ASSOCIATION WITH CONSTRUCTION OF THE "MODIFICATIONS TO SUNNY ISLES SEGMENT AND BEACH RENOURISHMENT AT MIAMI BEACH"

Ref: Florida Department of Environmental Protection Permit No.: 0126527-002-JC and

US Army Corps of Engineers (Jacksonville, Fl) RFP No.: DACW17-00-R-0025

I. BACKGROUND

The US Army Corps of Engineers (ACOE), Jacksonville District has received the above referenced Florida Department of Environmental Protection (FDEP) permit to renourish 2.75 miles of the Sunny Isles Beach in Miami-Dade County. Additionally, the ACOE has submitted a request to modify the permit and include an additional 2,500 feet of beach along northern Miami Beach, and establish a second pipeline corridor at the south end of the Sunny Isles segment.. Although the above referenced permit covers only the Sunny Isles segment is approved, the present mitigation plan considers the additional impacts associated with the conduct of the additional Miami Beach segment (as identified in the submitted modification request).

The renourishment will be accomplished using a hopper dredge, which would collect sand from approved borrow areas and pump the sand slurry to the beach via a submerged pipeline. Due to draft restrictions of the vessel and the topography of the ocean floor off the work areas, the dredge will be restricted to areas seaward of the eastern edge of the first reef. Thus, the submerged slurry pipeline would have to be placed across the hardground areas locally known as "first reef". The FDEP Permit provides for placement of the pipeline within a defined 50 ft. wide corridor across the reef areas. The modification presently under consideration requests a separate corridor for the Miami Beach segment, and an additional corridor at the southern end of the Sunny Isles segment. If the second corridor (south end of Sunny Isles) is approved and utilized, the amount of mitigation will be modified accordingly, using the methods detailed for determination impacts within the corridors. The considerations and mitigation discussion below is based on the use of one corridor per segment.

Preliminary impact assessments have been conducted by Miami-Dade Department of Environmental Resources Management (DERM) and submitted to the state. Based on these estimates up to 306m^2 of benthic impact is possible within the Sunny Isles pipeline corridor, and up to 400m^2 of benthic impact is possible within the proposed northern Miami Beach pipeline corridor. Post-pipeline removal assessments associated with previous similar pipeline placements have shown the actual (documented) impacts to be range between 20% and 80% of pre-project estimates. In consideration of the range of actual documented impacts, it is expected that between 141 m^2 and 565 m^2 of benthic impacts will be associated with the pipeline placements necessary for this project.

II. MITIGATION CONSIDERATIONS:

Mitigation for impacts associated with this project would have two components: (A) salvage (collection and re-stabilization) of dislodged and or fractured hard corals, and (B) "In-kind" mitigation by creation of benthic habitat through the placement of designed artificial reef modules.

A. Hard Coral Salvage and Stabilization. The salvaging and re-stabilization of hard corals would occur immediately after placement of the pipeline.

1. Early identification and isolation of impacted hard coral colonies or hard coral colonies in jeopardy (shaded by or directly under the path of the pipeline) is imperative. This work should be completed as soon as possible (within two weeks) following placement of the pipeline.
2. Relocation areas will be identified into which fractured and dislodged corals will be placed. This will facilitate tracking the survivorship of the relocated corals.
3. Corals will be relocated as close as possible to the location they were taken from.
4. Corals need to be re-stabilized using proven techniques and adhesives. The methods established and utilized by NOAA National Marine Sanctuary Restoration and Assessment Program (H. Hudson, pers. comm.) will be followed.

B. In-Kind Mitigation. Considerations for mitigation material includes:

1. Relief of mitigation material should be relatively low to approximate the relief of the impacted habitat.
2. Materials should provide habitat for a wide variety of fish, invertebrate (both motile and benthic) organisms
3. Mitigation should be constructed of materials similar to that of the impacted habitat (i.e., limestone or carbonate based).
4. Materials should be placed in as close a proximity to the impacted areas as possible.

III. MITIGATION COMPONENTS

Two materials would satisfy the considerations for materials and mitigation outlined above:

1. Limerock boulder, and
2. Prefabricated modules composed of pre-cast concrete culverts set in a high-pressure concrete base, and 6-12 inch limerock grouted to the exterior surfaces of the culverts.

We propose utilization of the prefabricated modules for the mitigation, leaving the limerock as an alternative, should the Department so desire to utilize it. If limerock were to be used, it would have to be multi-layered to achieve and intricate habitat appropriate for the mitigation. Multiple layers of limerock, however, would not allow the maintenance of "low relief" mitigation. The use of the prefabricated module was selected as they provide a much more highly complex benthic habitat than limerock boulders, while maintaining a relatively low relief (<5'). This modules is favorable for colonization by a broad spectrum of benthic and motile invertebrates and algae, and utilization by benthic and demersal fish. The modules (Figure 4) are modification of a design used in previous hard-ground impact mitigation programs (i.e., Sunny Isles Reef Restoration Off-site mitigation; Port of Miami dredge anchor impact mitigation, Bal Harbor sediment impact mitigation, and previous beach renourishment pipeline corridor impact mitigation). Additionally, the design of the module can easily be modified to enhance or minimize specific features (i.e., height, surface area, cryptic space) through varying of the number and size of the culvert pipes used in the construction of the units.

The proposed module overall size will be 6 ft (1.83m) wide by 9 ft (2.74m) long and 4 ft (1.22m) high. The area proposed for placement (see below) would provide for approximately 0.5 feet (0.15m) of settling, creating a habitat with approximately 3.5 ft relief. The design of the module will utilize a single layer of culvert pipes to minimize relief. The addition of the limerocks to the surface substantially increases the surface area of the module. The footprint area of each 6x9 ft. module is 54 ft^2 (5 m^2). The total surface of the module available for colonization is conservatively estimated to be 30 m^2, which provides a greater than 6:1 surface area-to-footprint ratio. The module design will be evaluated for stability in the water depth and area selected for placement. The weight of the module will be adjusted as necessary to insure appropriate stability.

IV. IN-KIND MITIGATION SITES

There are 11 designated offshore artificial reef sites in Dade County. The closest and preferred reef site, with depths comparable to those found in and around the first reef areas, is the "Anchorage Site" (center point - 25°48'43.5"; 80°05'35.5"; depth range 30 to 55 ft.), located approximately 7 miles south of the Sunny Isles segment and 3 miles south of the Miami Beach Section. The next best location is the "Port of Miami Mitigation Site – A", which is approximately 2 miles further south, with a water depth of 25 feet.

V. CALCULATION OF MITIGATION

The amount of impact within the corridor will be controlled by a number of factors: (i.e., need of repair or re-positioning of the pipeline which requires lifting and replacement; impact by accessory equipment [i.e., marker buoys]; the ability of the pipeline 'collars' to hold the portions of the pipeline off the reef; irregularities of the bottom assisting in holding the pipeline off the reef; and utilization of floating lines or cable motion dampeners on needed marking or lifting buoys to minimize impacts to areas adjacent to pipeline). The varied factors that can effect the amount of area impacted, and past assessments of pipeline impacts indicate actual impact will be less than estimated in the pre-project assessments. Therefore the area of impact, and subsequently, the area of mitigation will be determined by post-pipeline removal assessments.

<u>Impact Assessment Methodology</u>. The impact will be assessed by DERM biologists with experience in identification and evaluation of benthic impacts. Biologists will visually inspect the entire pipeline path to identify and quantify the area and amount (degree) of impact to benthic communities. Such methods will include measurement of all areas of

scarification, denudation, crushing or other modified bottom characteristics attributable to the pipeline and or accessory equipment. The degree of impact will be estimated on a scale of 0-25%, 25-50%, 50-75%, 75-100% and 100%. The actual area of impact will be the product of the measured area and the decimal equivalent of the 'mid-point' of the level of impact. The area requiring mitigation will be the sum of those products, plus the overall area of hard corals impacted (i.e., crushed, fractured, scraped or dislodged).

Mitigation Ratio Considerations. It is requested that the following considerations be taken into account in the determination of the required mitigation:

1. The project is being conducted in the interest of public health and safety (protection of property and life from storms, hurricanes and coastal flooding)
2. Physical alterations to the hardground will be minimal. Past pipeline placements indicate disturbance to the bottom from the pipeline will be significantly less than estimated in the pre-project assessment.
3. The region the pipeline traverses is dominated by sponges, algae and moderate sized soft corals, which have a relatively short recovery time (2-8 years).
4. Each module placed will provide a minimum of 30 m^2 of new benthic surface area of colonization and utilization by marine organisms.

Estimated Mitigation Requirement. In consideration of the points stated above, it is proposed to place one $5m^2$ prefabricated module for every $5m^2$ of benthic impact documented during the post-pipeline removal. Additionally, the habitat benefits of the modules can be enhanced through appropriate placement of the modules. Modules placed in proximity to each other, allow for interaction of the motile organisms, and can effectively function as a single unit, enhancing the effectiveness of the reef modules.

Based on the pre-project assessments, and in consideration of the range of actual impact levels documented, the projected impact associated with the two pipeline corridors will be between $141m^2$ and $565m^2$. This would require between 28.2 and 113 modules for mitigation, with the proposed mitigation requirement (i.e., 1 module per $5m^2$ impact). It should be noted that the actual amount of mitigation will be based on the documented impacts within the pipeline, and may be more or less from the estimates given above.